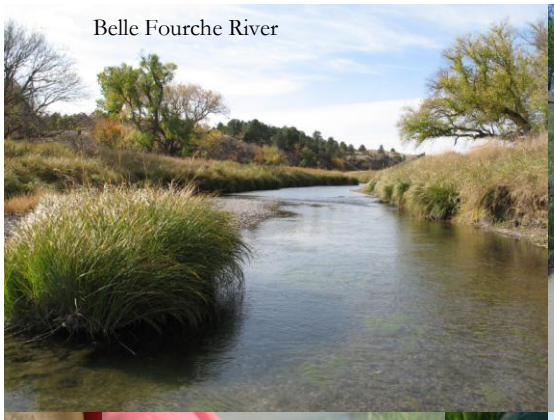
Northeastern Missouri River Basin


Belle Fourche River


Cheyenne River


Western spiny softshell turtle


Lance Creek

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Watershed Description

Three of the nation's major river systems have their headwaters in Wyoming: the Missouri, Colorado, and Columbia Rivers. Their watersheds provide a natural basis for delineating aquatic conservation areas. Six major watersheds were identified for conservation planning purposes under this State Wildlife Action Plan (SWAP) using hydrographic boundaries and fisheries assemblage and management considerations (Figure 5). These areas are consistent with the aquatic ecosystems identified for freshwater biodiversity conservation worldwide by Abell et al. (2008). The watershed areas are also synonymous with aquatic zoogeographical units and ecological drainage units identified under The Nature Conservancy's (TNC) hierarchical classification framework (Higgins et al. 2005). A systematic, hydrologic unit code (HUC)-based approach allows the nesting of multiple spatial and temporal scales for planning and for prioritizing conservation actions.

The Northeastern Missouri River basin includes four 6-digit HUCs, all direct tributaries to the mainstem Missouri River (Figure 5). These include the Little Missouri (101102), Belle Fourche (101202), Cheyenne (101201), and Niobrara River (101500) watersheds (Figure 5). Thirteen 8-digit HUCs and 52 10-digit HUCs occur in this area. These watersheds span an area of about 12,000 square miles in northeastern Wyoming's Crook, Weston, Campbell, Converse, Niobrara, and Goshen counties. Land ownership is 81% private. Public land is held primarily by the State of Wyoming (6%), Bureau of Land Management (5%), and U.S. Forest Service (4%).

The Northern Great Plains Steppe terrestrial-based ecoregion, as defined by Bailey (1995) and adapted by The Nature Conservancy, occupies most of the Northeastern Missouri River basin. Remaining portions of this basin are covered by TNC's Black Hills ecoregion. Elevations range from 3,125 feet where the Belle Fourche River leaves the state to over 6,600 feet in the Black Hills. Underlying geology consists of sandstone, shale, limestone, and igneous and metamorphic rocks. The Pierre Formation, Fort Union Formation, and Lance Formation underlie the area and consist of shales, sandstones, and thick coal beds (Lageson and Spearing 1988). This region has not experienced continental glaciation and hence lacks the U-shaped valleys and material deposit features associated with glacial activity.

The Northeastern Missouri River basin overlaps part of Wyoming climate division 5 and all of divisions 6 and 7 (Curtis and Grimes 2004). These climate divisions are the warmest of the 10 climate divisions in Wyoming with average monthly temperatures of 71º F in July. The coldest month is January and averages about 20º F. The Belle Fourche drainage receives the highest monthly precipitation in the state with nearly 3 inches falling in June on average over the period 1931–2000 (Curtis and Grimes 2004). The Cheyenne and Niobrara drainages receive about 2.5 inches during the peak month of May. The Northeastern Missouri River basin is different from Wyoming's other river basins in that it receives the bulk of its annual precipitation during the warmest portion of the year. Annual precipitation ranges from about 13 inches to approximately 30 inches at high elevation along the eastern edge of the Black Hills.

Knight (1994) describes a diverse floristic community in the Black Hills with representative flora from eastern deciduous forests, the Rocky Mountains, the Great Basin, the Boreal Forest, and the Southern Great Plains. The ponderosa pine woodland and savannah grass understory of the Black Hills region constitutes a distinct vegetation community. The remaining watershed area can generally be described as largely prairie grassland and sagebrush steppe. A systematic and more detailed description of land cover follows.

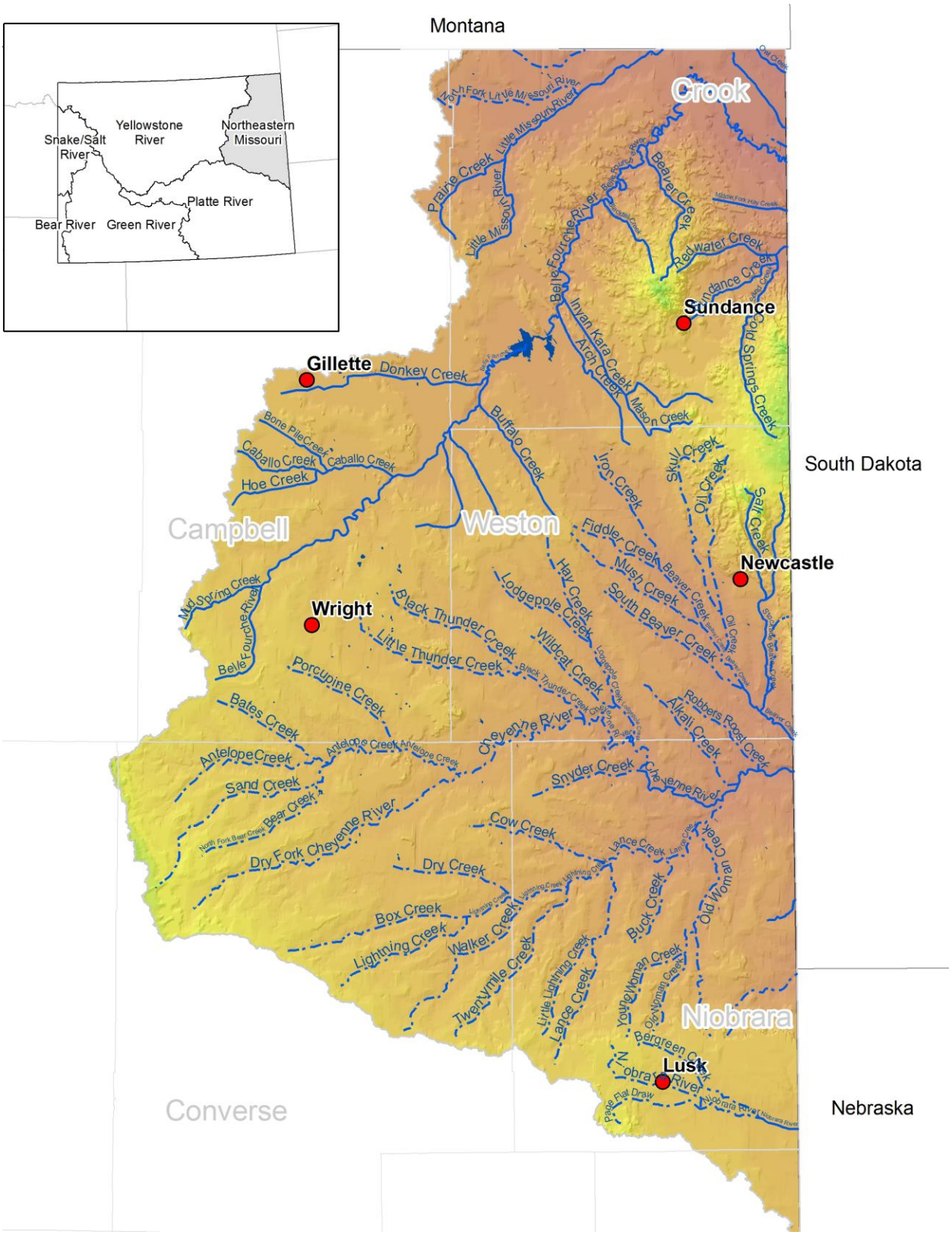

Figure 5. Northeastern Missouri River Basin.

The 11 habitat types defined in this SWAP (e.g., sagebrush shrublands, riparian, etc.,) are based on combinations of Ecological Systems (ES) developed by NatureServe (Comer et al. 2003a, NatureServe Explorer 2009). The determination and delineation of ES is based on land cover maps produced by the Northwest Gap Analysis Project (NWGAP 2010). Lennartz et al. (2007) provides technical details on the ES classification for USGS mapping zone 29, in which the whole of the Northeastern Missouri River basin occurs. Of the 173 ES classes identified under NWGAP, 73 classes occur in the Northeastern Missouri River basin (excluding developed and open water classes). The most prevalent classes are the Northwestern Great Plains Mixed Grass Prairie and the Inter-mountain Basins Big Sagebrush Steppe which are associated with the prairie grasslands (42% of watershed area) and sagebrush shrublands (38% of watershed area) habitat types. These habitats and their associated species assemblages, threats, and conservation actions are covered in separate habitat chapters of this SWAP.

Land use is primarily livestock grazing on the plains. Oil, gas, and coal deposits occur, and coal mining is extensive (Chapman et al. 2004). Coal bed methane production occurs primarily on the western edge of the basin. Within the Black Hills, timber harvest has been historically extensive (Knight 1994). Other Black Hills activities include gold, copper, and gypsum mining, recreation, and ranches in the valley bottoms (Chapman et al. 2004).

The Belle Fourche, Cheyenne, Little Missouri and Niobrara Rivers in Wyoming have their headwaters almost entirely in the plains. From a GIS analysis of the 2010 Version 2.0 National Hydrological Database (NHD) at 1:100,000, there are approximately 44,000 miles of streams in the Northeastern Missouri River basin. This equates to a drainage density of about 3 ½ miles of stream per square mile land area. While it is certain that many of the line segments depicted as streams in the NHD are intermittent or ephemeral, providing a precise estimate of perennial stream miles is fraught with uncertainty. A rough surrogate may be named stream miles from the NHD layer, which constitutes about 8,000 stream miles. Major named streams include the Little Missouri River, Belle Fourche River, Redwater Creek, Beaver Creek, Blacktail Creek, Lytle Creek, Miller Creek, Inyan Kara Creek, Donkey Creek, Arch Creek, Cheyenne River, Antelope Creek, Lightning Creek, Lance Creek, Beaver Creek (Cheyenne River basin), and Stockade Beaver Creek, and the Niobrara River (Northeastern Wyoming River Basins Water Plan Final Report, 2002).

The largest water body in the Northeastern Missouri River basin is Keyhole Reservoir on the Belle Fourche River with an active capacity of 185,800 acre feet (af) (Northeastern Wyoming River Basins Water Plan Final Report, 2002). Other reservoirs having significant capacity are few and much smaller and include Tract 37 Reservoir on the North Fork Little Missouri River (2,454 af), Spencer Reservoir on Stockade Beaver Creek (2,162 af) and Gillette Reservoir on Donkey Creek (2,080 af). Stock ponds are defined by the Wyoming State Engineers Office as 20 af or less impoundments; 5,093 permitted stock ponds occur in the basin (Northeastern Wyoming River Basins Water Plan Final Report, 2002).

Total annual runoff among the major drainages includes 4,900 acre feet per year on the Cheyenne River at Riverview (5,160 square mile drainage area) and 16,550 acre feet per year from the Belle Fourche River below Moorcroft (1,690 square mile drainage area) (Clark and Mason 2007). Higher yields per area in the Belle Fourche drainage occur from additional precipitation in the higher elevations of the Black Hills. Runoff patterns include spring peaks from lowland snowmelt, intermittent peaks following rainstorms, and extended periods of low flow (Clark and Mason 2007). The Cheyenne River commonly has extended periods of no flow. Stream gradients are generally low in the plains streams, under 1.0%, and consist of meandering sinuous channels. Corresponding water velocities are generally low as well, though localized regions of high

velocities occur in addition to high velocities during peak flow events.

Water quality is influenced strongly by the slow moving nature of the streams as they flow over soluble geologic materials (Clark and Mason 2007). For example, median conductance values in the Belle Fourche drainage ranged up to 2,800 μS/cm (Clark and Mason 2007). Dissolved sodium, sulfates, and carbonates are common with the highest levels for the Northeastern Missouri River basin occurring in the Cheyenne River drainage.

Aquatic Wildlife

Fish

The first fish community surveys in the Northeastern Missouri River basin were conducted in the 1890s (Evermann and Cox 1896). Fifty years passed before James Simon published the first edition of *Fishes of Wyoming*, which includes the results of his fish surveys which began in 1933 (Simon 1951). He surveyed 11 sites in the Northeastern Missouri River basin. Over the next three decades, a few projects provided some additional information on distribution of fishes in this watershed (Eiserman 1966, Baxter and Simon 1970, Fleisher 1978, Fleisher and Stone 1978); however, many gaps remained in the survey data.

In 1992, the WGFD funded a PhD project at the University of Wyoming to conduct a detailed fisheries survey of warmwater fishes in the Missouri River drainage in Wyoming. The dissertation and publications associated with this survey of 181 locations from 1993-1995 are some of the most cited references pertaining to warmwater fishes in Wyoming and include estimates of species richness and relative abundance, in addition to rankings of the relative conservation value of 83 streams for native fish species (Patton et al. 1995, Patton 1997, Patton et al. 1998, Patton 2001). This survey included five sites in the Little Missouri River watershed, eight sites in the Belle Fourche, nine sites in the Cheyenne, and five sites in the Niobrara River watershed. Information from Patton's 1993 surveys was included in the fourth edition of *Fishes of Wyoming* (Baxter and Stone 1995). In 2002, the WGFD conducted a large-scale literature and data review and produced a series of twelve reports (Weitzel 2002) that describe the distribution, status, and life histories of 41 native, nongame fishes. Eight of these reports pertain to fishes native to the Northeastern Missouri River basin. Miller and Weitzel (2003) prioritized native nongame fishes for future conservation efforts and made recommendations for management of these species. These reports (Weitzel 2002, Miller and Weitzel 2003) provided much of the information that was used to develop fish portions of the 2005 Comprehensive Wildlife Conservation Strategy for Wyoming.

In 2004, a State Wildlife Grant (SWG) project was initiated to gain additional information regarding native fish distributions and their habitats in eastern Wyoming prairie streams to begin developing strategies to manage and conserve native fish species. In 2004 and 2005, surveys were conducted at a total of 41 sites in the Little Missouri (8 sites), Cheyenne (28 sites), and Niobrara River (5 sites) watersheds using the Warmwater Stream Assessment (WSA) (Quist et al. 2004). The results of this project were summarized in two completion reports. Barrineau et al. (2007) includes results of surveys in the Little Missouri and Cheyenne River drainages. Bear and Barrineau (2007) includes results for the Niobrara River surveys. Both reports include descriptions of habitat conditions and threats to native species in each watershed, the results of fish and habitat surveys, and management recommendations for these prairie streams. The Belle Fourche watershed was not surveyed as part of this project.

In 2005 and 2006, a number of fisheries surveys were conducted in the Belle Fourche and Cheyenne River drainages to describe communities in areas undergoing extensive coalbed methane development (Peterson et al. 2009). In March 2008, two 2-year SWG

projects (Northeastern Wyoming Prairie Fish Conservation and Southeastern Wyoming Prairie Fish Conservation) were initiated. As part of the Northeastern Wyoming project, detailed fish and habitat surveys were conducted in the Belle Fourche River and Redwater Creek watersheds (McGree et al. 2010, Moan et al. 2010).

The fish community in the Northeastern Missouri River basin has been sampled for more than 100 years. Survey intensity has increased dramatically in the last 20 years. Results show that tThe Northeastern Missouri River basin is home to the most diverse fish community in the state. Forty-seven fish species are found in the watershed, 23 of which are native and 10 of which are Species of Greatest Conservation Need (SGCN). No native species has been completely extirpated from the Northeastern Missouri River basin, but two species that are SGCN elsewhere in the state have been introduced to the watershed; Snake River cutthroat trout and plains killifish. The plains topminnow (SGCN) was most likely native only to the Niobrara River basin, but has been documented in the Cheyenne River basin.

The native gamefish community is composed only of three ictalurids: channel catfish, black bullhead, and stonecat. The nonnative fish community consists of 25 introduced species, of which 14 are game species that have been stocked to provide fishing opportunities in standing waters. Introduced game species include important sport fishes such as trout, walleye, yellow perch, northern pike, tiger muskie, bass, crappie, and sunfishes.

High stream flow fluctuation, high summer water temperatures, stream flow alteration, long periods of low flow, high turbidity, and siltation limit the potential of most streams and standing waters in the drainage to support game fish, particularly cold water species.

Streams originating west of the Black Hills are typified by extreme flow fluctuations. They are often intermittent in the summer but may flood at any time during summer storm events. Low steam flow can result in a variety of environmental and abiotic stressors and conditions for fish, and the continuing drought over at least the last decade has most certainly affected fish in the Cheyenne River basin (Barrineau et al. 2007).

Comparisons of data collected in the 1960s and the 1990s suggest that of the fish species present within the Belle Fourche River basin, nine have declined over this 30-year period (Patton 1997). The finescale dace (FSD), flathead chub (FHC), fathead minnow (FHM), lake chub (LKC), mountain sucker (MTS), shorthead redhorse (NRH), plains minnow (PMN), river carpsucker (RCS), and stonecat (STC) have declined on spatial scales described by Patton as site, stream, subdrainage, and drainage levels, compared with those of the 1960s sampling conducted by Baxter and Simon. Patton (1997) suggests that it is critical to monitor fish distributions and abundances, and to identify conservation needs prior to irreversible imperilment. McGree et al. (2010) found that five species (FHC, LND, MTS, PMN, and STC) had declined when comparisons were made to Patton (1997).

Aquatic Reptiles

Three turtles are found in the Northeastern Missouri River basin, all of which are native species. The western painted and western spiny softshell turtles are SCGN, but the eastern snapping turtle is not. The western spiny softshell turtle is believed to have the widest distribution in the watershed of the three. All three species are suspected to reside in subdrainages throughout the Northeastern Missouri River basin. However, actual observations are very limited (see Species Accounts). The eastern snapping turtle has been documented in the Niobrara, Cheyenne and Belle Fourche drainages and is suspected to occur in the Little Missouri River. The western painted turtle has been documented in the Cheyenne and Belle Fourche, whereas the western spiny softshell has only been documented in the Belle Fourche. Baseline survey data are needed for all turtles in the Northeastern Missouri River basin.

Table 5. Fishes present in the Northeastern Missouri River Basin. Species of Greatest Conservation Need (SGCN) are followed by an asterisk (*).

Native game	Native nongame	Nonnative game	Nonnative nongame
Black bullhead	Creek chub	Black crappie	Brook stickleback
Channel catfish	Brassy minnow*	Bluegill	Carp
Stonecat	Central stoneroller*	Brook trout	Emerald shiner
	Fathead minnow	Brown trout	Freshwater drum
	Finescale dace*	Green sunfish	Gizzard shad
	Flathead chub*	Largemouth bass	Golden shiner
	Goldeye*	Northern pike	Grass carp
	Iowa darter*	Rainbow trout	Longnose sucker
	Lake chub	Smallmouth bass	Plains killifish
	Longnose dace	Snake River cutthroat	Spottail shiner
	Mountain sucker	Tiger muskie	
	Pearl dace*	Walleye	
	Plains minnow*	White crappie	
	Plains topminnow*	Yellow perch	
	Red shiner		
	River carpsucker		
	Sand shiner		
	Shorthead redhorse		
	Western silvery minnow*		
	White sucker		

Freshwater Mollusks and Crayfishes

All native mussels, clams, and gastropods are considered SGCN by WGFD due to a lack of information regarding status. Few published accounts exist (Beetle 1989, Henderson 1924, Hoke 1979, Hovingh 2004), but native mussel populations are currently present in every major drainage of Wyoming, except the Green River and Great Divide. Wyoming is still in the discovery phase in terms of its freshwater mussels and gastropods, but the WGFD has intensified sampling efforts in recent years. One biologist on the aquatic assessment crew has been assigned to coordinate mollusk sampling and collect observations. Field personnel have been trained and instructed to record mussel observations during other routine fieldwork and submit specimens. A voucher specimen collection was established at the University of Colorado Natural History Museum in Boulder, Colorado, in 2007.

As of late 2010, seven species of native mussels were known to inhabit Wyoming waters. Two of these species, the giant floater and the white heelsplitter, have been documented in the Northeastern Missouri River basin. Giant floater have been documented in portions of the Little Missouri and Belle Fourche river drainages while heelsplitter have been found only in the Blacktail Creek drainage in the Belle Fourche watershed.

Little is known about the current distribution of Wyoming gastropods. Beetle (1989) contains some of the only published observations in Wyoming, listing species occurrences by county. Beetle (1989) reported pouch snails (genus *Physa* and *Gyraulus*) and pond snails (genus *Lymnaea*) in the Belle Fourche and Cheyenne River drainages. No observations were reported in the Niobrara or Little Missouri River drainages, but sampling sites were extremely sparse.

In 2009, the WGFD funded a project at the University of Wyoming (UW) to conduct a literature review, identifying the current and

historical information on freshwater gastropod distributions in Wyoming and to develop gastropod collection methods for WGFD and assess the distribution of freshwater gastropods in the Bighorn and North Platte river drainages in Wyoming. This project did not include sampling in the Northeastern Missouri River basin. The results of the UW research project will provide direction for sampling methods. Baseline survey data are needed for all gastropods in the Northeastern Missouri River basin.

Little information is available on the distribution of Wyoming crayfishes. All native crayfishes are considered SGCN. Between 1985 and 1987 a survey of crayfishes was conducted (Hubert 1988). During that survey five species of crayfishes were found in Wyoming: *Pacifasticus gambelii, Orconectes immunis, O. virilis, O. neglectus, and Cambarus diogenes*. During subsequent surveys conducted from 2007-2009, *Orconectes immunis* was the only species documented in the Northeastern Missouri River basin (Hubert 2010). More detailed surveys are needed to describe the distribution and status of crayfishes in the state.

Table 6. Species of Greatest Conservation Need present in the Northeastern Missouri River Basin.

Fish
Brassy minnow
Central stoneroller
Finescale dace
Flathead chub
Goldeye
Iowa darter
Pearl dace
Plains minnow
Plains topminnow
Western silvery minnow

Reptiles
Western painted turtle
Western spiny softshell

Crustaceans
Calico crayfish

Mollusks
Giant floater mussel
White heelsplitter mussel

Identification of Conservation Areas

The 2004–2005 (SWG) projects on eastern Wyoming prairie streams (described above) evaluated the utility of the Warmwater Stream Assessment (WSA) methodology for assessing stream habitat conditions and greatly refined our understanding of the distribution of native fish species. Data from this project were used to prioritize large watersheds in eastern Wyoming based on conservation value for native species. Most of the watersheds identified are also regional Aquatic Habitat Priorities.

The priority watersheds that were identified in northeastern Wyoming include Lance, Indian and Black Thunder creeks in the Cheyenne River watershed, and the Little Missouri and Niobrara River watersheds. At least 11 SGCN occur in one or more of these watersheds: finescale dace (NSS2), pearl dace (NSS2), western silvery minnow (NSS2), goldeye (NSS3), Iowa darter (NSS3), plains minnow (NSS3), plains topminnow (NSS3), brassy minnow (NSS4), central stoneroller (NSS4), and flathead chub (NSS4).

One of the objectives of the two 2-year SWG projects initiated in March 2008 was to use results from additional fish surveys to prioritize watersheds at the 10-digit HUC level for native fish conservation efforts. Detailed surveys were conducted at 11 sites in the Little Missouri River drainage, 36 sites in the Belle Fourche River drainage, 24 sites in the Cheyenne River drainage, and 17 sites in the Niobrara River drainage.

Priority fish conservation areas (Figure 6) include the Little Missouri (HUC 10110201), Niobrara River drainage (HUC 10150002), lower Cheyenne River (HUCs 1012010304 and 1012010601), and Black Thunder Creek (HUC 1012010302) and Lance Creek (HUC 10120104) in the Cheyenne River drainage (10120106).

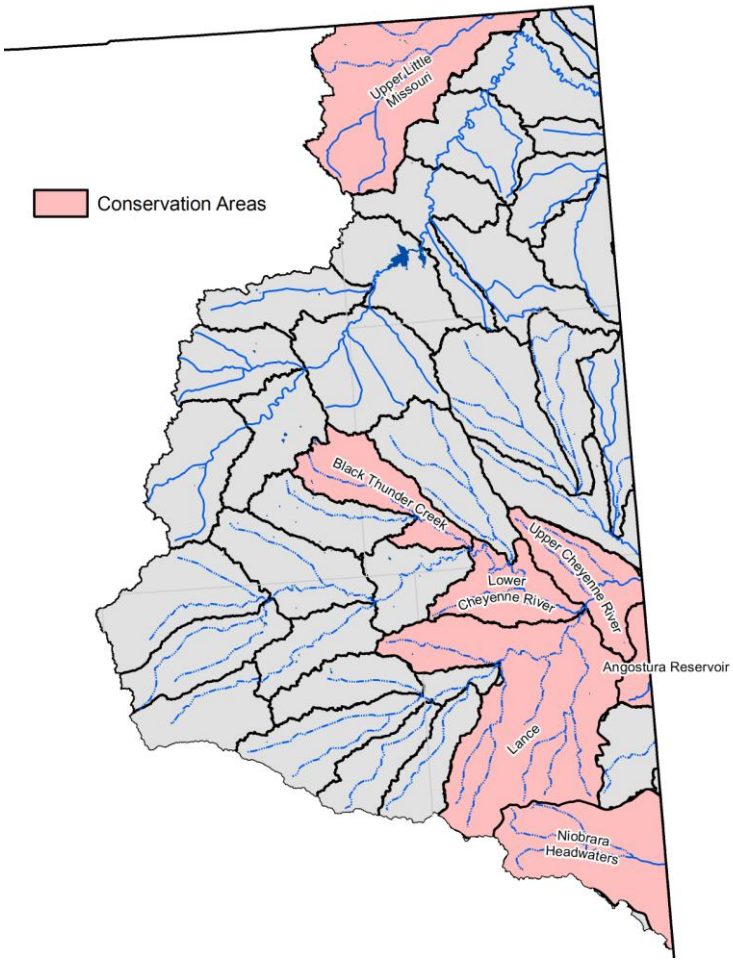

Figure 6. Aquatic Wildlife Conservation Areas in the Northeastern Missouri River Basin.

Threats

Water development/altered flow regimes – Moderate

Natural flow regimes in stream segments around the state have been altered by human activities including irrigation diversions and water developments for more reliable water supply, hydropower, and flood control. These altered flow regimes are also a consequence of broad-scale changes in land use and management associated with agriculture, grazing, timber harvest, and housing development (see Wyoming Leading Wildlife Conservation Challenges – Disruption of Historic Disturbance Regimes). The majority of the Northeastern Missouri River basin is grasslands or sagebrush. There is some irrigated cropland and relatively few water storage reservoirs.

Groundwater use in prairie systems has been shown to negatively impact stream flow, increasing the extent and duration of dry or intermittent stream channels. Native prairie fishes evolved in a highly dynamic system and readily recolonize areas that periodically dry out. Key to the ability to recolonize is lateral and longitudinal hydrologic connectivity and physical access by fish populations to all habitats necessary to complete their life history. In-channel obstructions and increased drying have reduced some populations of native stream fishes.

Coal bed natural gas development can generate surplus water that may be discharged into streams. Besides altering the natural hydrograph, increased flow can change water temperature and quality. Some of these changes can favor exotic species which negatively impact the native fish community through predation and competition.

The need for additional water for human use will intensify in the immediate future, and that trend will be especially evident in the western U.S. This trend has multi-faceted consequences for fish and wildlife and the habitats upon which they depend. In Wyoming, trans-basin water diversions are not uncommon and are likely to be further proposed and pursued. Energy diversification, including hydropower development, may increase as the nation's energy demands rise. Warmer conditions with more erratic precipitation— which some predict for Wyoming's future climate—may heighten the need for additional water development (water storage) for municipal and agricultural purposes.

The likely trend will be water development projects closer to the delivery point and conveyance via pipelines instead of stream channels. Additional emphasis will likely be placed on lining irrigation ditches and other practices to more efficiently use water for consumptive purposes. The net effect of all such water management practices will be to alter the timing, magnitude, and duration of natural hydrographs and reduce intra- and inter-annual variability in Wyoming's streams and associated riparian corridors (see Wyoming Leading Wildlife Conservation Challenges – Climate Change).

While water development can threaten native species, some introduced species, including those in popular sport fisheries, have thrived in the face of water development. The simplification of natural systems by human development tends to favor species with generalized and broad habitat requirements. For example, the diverse and productive fishery in Keyhole Reservoir depends on the forage production inherent in a man-made water body. Stable stream flow releases from dams, with relatively low peak flows and relatively high base flows, perpetuate productive sport fisheries.

Drought and climate change – Moderate
Climate change may increase air and surface water temperatures, alter the magnitude and seasonality of precipitation and runoff, and shift the reproductive phenology and distribution of plants and animals (Seavy et al. 2009) (see Wyoming Leading Wildlife Conservation Challenges – Climate Change). Changes in precipitation patterns under various climate change scenarios are predicted to produce peak flows earlier in the yearly cycle and to lower base flows (Barnett et al. 2004).

Drought lowers water tables, leading to reduced plant growth and reproduction. Riparian vegetation declines lead to lower bank stability, higher siltation and altered stream habitat quality and quantity. Lower water levels increase water temperatures and reduce the habitat available to fish and other aquatic wildlife. All these conditions can be detrimental to the health and reproductive success of all aquatic wildlife species.

Invasive species – Moderate
The primary threats from invasive species in the Northeastern Missouri River basin are from colonization of nonnative predators such as northern pike, yellow perch or black crappie.

Aquatic invasive species (AIS) including fish, pathogens, plants, and mollusks are currently present in Wyoming, most notably the New Zealand mudsnail and the parasite that causes whirling disease. These AIS can alter the native species in a watershed through competition, disease, shifts in food availability, and direct mortality. While AIS currently in Wyoming can cause problems and need to be controlled, the most significant known threat to Wyoming's native species is from zebra and quagga mussels, based on their proximity to Wyoming and demonstrated negative impacts in other areas. Zebra and quagga mussels can out-compete native mussels for space and resources and will attach to and smother native mussels causing mortality (Cummings and Mayer 1992, Strayer 2008). They filter plankton out of the water

column at high rates (up to a liter per day per individual) so that little plankton remains available for fish populations, resulting in their decline (Benson 2009). In addition, invasive mussels produce pseudofeces which can lead to harmful algal blooms affecting numerous aquatic species.

The Wyoming Aquatic Invasive Species Act of 2010 allowed the WGFD to implement the Wyoming AIS Program with the goal of executing a coordinated strategy to prevent, control, contain, monitor, and whenever possible, eradicate aquatic invasive species from the waters of the state. The Wyoming AIS Management Plan of 2010 is the framework for this three-part strategy which includes 1) outreach and education, 2) inspection of watercraft to increase boater awareness of AIS threats and prevention and to intercept high risk watercraft that may be transporting AIS, and 3) monitoring of waters to allow for early detection and rapid response to any new AIS populations in the state.

Rural subdivision and development – Locally High /Moderate
The Black Hills have a greater level of rural development with continued interest in development of recreational properties. The primary aquatic impact is through increased water use.

Conservation Initiatives

A number of projects have been conducted recently that have contributed significantly to our understanding of aquatic wildlife SGCN in the Northeastern Missouri River basin. State Wildlife Grant (SWG) program funds were used to complete detailed inventories of fish assemblages and stream habitat throughout eastern Wyoming prairie streams in 2004 and 2005 using the Warmwater Stream Assessment technique (Quist et al. 2004). Survey results are reported in Barrineau et al. (2007) and Bear and Barrineau (2007), and the Warmwater Stream Assessment is evaluated in Bear (2007).

Two follow-up projects were initiated with SWG funds in 2008. The objectives were to complete baseline surveys in the Belle Fourche watershed in Wyoming, to conduct additional surveys in drainages surveyed during the 2004 and 2005 project using a technique based on the Montana Fish and Habitat Sampling Protocol (Bob Bramblett, Montana State University, personal communication) and the Environmental Protection Agency's Environmental Monitoring and Assessment Protocol (Peck et al. 2001), and to prioritize streams in eastern Wyoming for future native fish conservation efforts (McGree et al. 2010, Moan et al. 2010).

These SWG-funded projects have drastically improved our understanding of native fish distributions and habitat associations in the Northeastern Missouri River basin and have enabled managers to identify priority watersheds for future efforts (see Identification of Conservation Areas, above).

The WGFD's Fish Division has developed basin management plans to guide management across the state. These plans provide background and history of aquatic wildlife management as well as management direction for sportfish, SGCN, and aquatic habitat. The management direction includes reference to the SWAP and the Strategic Habitat Plan, in order to incorporate management direction from those two plans that is relevant to each basin into each basin management plan.

The WGFD has recently initiated a statewide fish passage program. The effort so far has lead to the identification and prioritization of structures in need of passage restoration and the training of individuals in all regions in basic fish passage knowledge. Several diversion dams have been identified as problematic for fish passage, and projects are being developed to make these structures fish friendly.

The WGFD has the opportunity to comment on most environmentally sensitive construction or management actions submitted through the National Environmental Policy Act (NEPA) review process. Projects include state and

federal lands and private ventures that require action by state or federal agencies. The WGFD regularly provides recommendations to protect habitat and populations of aquatic wildlife at the project level. Department efforts are guided by Wyoming Game and Fish Commission mitigation policy (WGFC 2008).

The WGFD has a rigorous collection permitting system that restricts commercial, scientific, and educational activities (WGFC 2005a). It provides protection to aquatic wildlife. The regional fisheries supervisor reviews all requests for permits and recommends either approval or rejection of the request based on merit and impacts to the resource in question.

The movement of fish by WGFD employees is critical to address many of the aspects, thus the intent, of our mission. However, the act of moving or importing fish also presents risks that could potentially jeopardize that mission. To address this conflict, a method to determine the relative level of risk associated with any proposed fish importation and/or transplant was developed. The WGFD utilizes Hazard Analysis and Critical Control Point (HACCP) procedures (Gunderson and Kinnunen 2001) and has developed a risk assessment matrix from these procedures to manage transplants, thereby protecting the aquatic resources within the state. Using the procedures and matrix, WGFD fisheries managers develop documentation that explains whether a transplant is nearly free of risk. The documentation must address all aspects of the transplant, including, but not limited to, verifying that the fish being transplanted are disease free, the water source is disease free, and non-target species are excluded from transplant. Source populations of salmonids are verified disease free by collecting a standardized number of fish, having them inspected by an American Fisheries Society-certified Fish Health Inspector for all known pathogens, and receiving disease free certification. The resulting documentation is reviewed and either approved or denied by the WGFD Chief of Fisheries. No whirling disease-infected trout, native or nonnative, are stocked by the WGFD, and they are not allowed to be stocked by others (WGFC 2003).

In Wyoming, state Game and Fish Commission policy precludes the stocking of fish into waters that are capable of maintaining satisfactory, self-sustaining fisheries (WGFC 1998). A common sense, biologically based protocol for fish rearing and stocking has historically been followed in Wyoming, with emphasis on management for native fish and wild fish wherever possible (Wiley 1995). Only 3% of the streams listed in the Wyoming Game and Fish Department database inventory are stocked annually. Maintenance of native cutthroat trout subspecies has been a management priority for more than 40 years (Stone 1995), and protection of native nongame fishes from stocked predators has been an important consideration for at least the last decade.

Wyoming has regulations prohibiting unauthorized stocking of fish or fish eggs. Private citizens can only stock waters in Wyoming following a WGFD permitting system that includes review by the responsible regional fisheries supervisor (WGFD 2005b). The WGFD has increased education efforts regarding the problems associated with illegal introductions of fish. The Wyoming Legislature increased the penalties for illegal fish stocking in 2010, and the Wyoming Wildlife Protectors Association has offered $2,500 rewards for information leading to the conviction of individuals found illegally moving or stocking fish.

Habitat management efforts are guided by the Strategic Habitat Plan (SHP) that was adopted by the Wyoming Game and Fish Commission in January 2009 (WGFC 009). The SHP includes five goals: 1) Conserve and manage wildlife habitats that are crucial for maintaining terrestrial and aquatic wildlife populations for the present and future, 2) Enhance, improve, and manage priority wildlife habitats that have been degraded, 3) Increase wildlife-based recreation through habitat enhancements that maintain or increase productivity of wildlife, 4) Increase public awareness of wildlife habitat issues and the critical connection between

healthy habitat and abundant wildlife populations, and 5) Promote collaborative habitat management efforts with the general public, conservation partners, private landowners, and land management agencies. Efforts are focused in priority areas in each of the management regions and include crucial areas essential for conservation of important species and communities, and enhancement areas, which represent places where work should be conducted to manage or improve wildlife habitat.

The Wyoming Legislature created the Wyoming Wildlife and Natural Resource Trust (WWNRT) in 2005. Funded by donations, legislative appropriation, and interest earned on a permanent account, the purpose of the program is to enhance and conserve wildlife habitat and natural resource values throughout the state. Any project designed to improve wildlife habitat or natural resource values is eligible for funding. The WWNRT is an independent state agency governed by a nine-member citizen board appointed by the Governor. The WGFD has partnered with the WWNRT to successfully implement a wide range of projects to benefit a broad array of Wyoming's wildlife.

Landscape Conservation Cooperatives (LCCs) are a new program of the U.S. Fish and Wildlife Service. The vision is that they serve as applied conservation science partnerships focused on a defined geographic area that inform on-the-ground strategic conservation efforts at landscape scales. LCC partners include U.S. Department of Interior agencies, other federal agencies, states, tribes, non-governmental organizations, universities, and other stakeholders. It is hoped that LCCs will enable resource management agencies and organizations to collaborate in an integrated fashion within and across landscapes. LCCs are intended to provide scientific and technical support to inform landscape-scale conservation using adaptive management principles. They are proposed to engage in biological planning, conservation design, inventory and monitoring program design, and other types of conservation-based scientific research, planning, and coordination. It is hoped that LCCs will play an important role in helping partners establish common goals and priorities, so they can be more efficient and effective in targeting the right science in the right places. Products developed by LCCs should inform the actions of partners and other interested parties in their delivery of on-the-ground conservation. The WGFD will continue to participate in the LCC process as appropriate.

The National Fish Habitat Action Plan (NFHAP) was developed by a coalition of fisheries professionals, state and federal agencies, tribes, foundations, conservation and angling groups, businesses, and industries, all determined to reverse the declines of America's fish habitats. In its design, the plan encompasses five important lessons that emerge from America's past efforts to protect and restore fish habitat: 1) Be strategic rather than merely opportunistic, 2) Address the causes of and processes behind fish habitat decline, rather than the symptoms, 3) Provide increased and sustained investment to allow for long-term success, 4) Monitor and be accountable for scientifically sound and measurable results, and 5) Share information and knowledge at all levels from local communities to Congress. The Wyoming Game and Fish Department has been heavily involved with the development and implementation of the NFHAP. WGFD is involved with three NFHAP partnerships, Great Plains Fish Habitat Partnership, the Western Native Trout Initiative, and the Desert Fishes Habitat Partnership. Only the Great Plains Fish Habitat Partnership covers this basin.

The Great Plains Fish Habitat Partnership is a coalition of interests concerned for the future of the rivers and streams of the Great Plains of the north central United States and the species that rely on these unique habitats. The Partnership is comprised of individuals, groups, and organizations that recognize the values of these aquatic habitats to fish and aquatic species, communities, and people who call this area home. The goal of the partnership is to work together to conserve (protect, restore, and

enhance) aquatic resources of rivers and streams throughout the prairies of the central United States. This partnership will focus on the conservation of remaining high quality prairie rivers and streams, the restoration of highly degraded habitats, where feasible, and the enhancement of habitats that have been moderately impaired. Wyoming is an active participant in the Great Plains Fish Habitat Partnership.

Recommended Conservation Actions

Secure and enhance populations and habitats in SGCN priority areas.
Evaluate the feasibility of reducing populations of or removing nonnative fishes from priority conservation areas in the basin.

Protect native fish populations in the Niobrara drainage.
Install a fish passage barrier on the mainstem Niobrara River near the Wyoming-Nebraska border if nonnative fishes are detected in Wyoming (Moan et al. 2010).

Exclude stocking of nonnative species on the mainstem Niobrara River and Van Tassell Creek (Moan et al. 2010). Ensure that sportfish are stocked only in off-channel waters.

Describe the distribution and intactness of aquatic habitats.
Describe temporal and spatial patterns of stream flow and diversions in SGCN priority areas. Developing a better understanding of patterns of water availability and constraints may highlight opportunities for focused conservation action.

Protect relatively intact riparian systems and restore those in proximity to SGCN priority areas.
Remove invasive and noxious vegetation from riparian areas in the lower Cheyenne River and Lance Creek watersheds (McGree et al. 2010).

Develop restoration projects to actively or passively rehabilitate riparian habitats and oxbow cutoffs. Promote active channel restoration where passive approaches prove inadequate.

Explore conservation easements or other land protection approaches to preserve natural characteristics of stream and riparian corridors.

Maintain the free-flowing condition of the Cheyenne River and tributaries.

Explore water management approaches that enhance fish habitat.
Identify opportunities to work with private water right holders to manage water diversions and uses with the goal of restoring natural flow regimes. Where opportunities exist, develop cooperative strategies with landowners and other partners to implement strategies that are beneficial to aquatic resources.

Identify stream segments where habitat and available flow regimes indicate a need to file instream flow water rights for SGCN. As opportunities are identified, conduct needed studies and file for state-held instream flow water rights.

Identify fish and wildlife mitigation for new reservoirs as they are proposed including instream flow regimes and minimum fishery pools. Ensure that mitigation recommendations are included as conditions in applicable permits.

Increase educational efforts about the ecological, economic, and social values of aquatic SGCN.
The importance and role of aquatic SGCN is poorly understood by the general public. Efforts should be enhanced to increase public education in this area.

Continue building voucher collections for all aquatic wildlife.
Continue to fill voids in voucher inventory for fish per WGFD protocol (Zafft and Bear, 2009).

Mussel specimens have been donated to the University of Colorado Museum, and new specimens will be added as needed. A database containing freshwater mussel occurrences will

be maintained and enhanced with specimen photos.

Determine if there is interest in voucher specimens of gastropods. If so, expand the voucher program to include those organisms.

Complete the comprehensive survey for freshwater mussels.
Future efforts will focus on filling gaps in distribution information, initiating comprehensive drainage surveys, maintaining department records, and expanding specimen collections.

Follow up on recommendations from the graduate research project on gastropods.
The WGFD-funded graduate project at the University of Wyoming will provide direction for sampling methods. Those recommendations should be followed, and baseline gastropods surveys should be conducted in the Northeastern Missouri River basin.

Increase connectivity where appropriate.
Remove barriers to provide connectivity within the Cheyenne River drainage and mainstem Little Missouri River (McGree et al. 2010).

Remove nonnative species from the North Fork Little Missouri River.
Chemically treat the North Fork Little Missouri River, salvaging native species while removing nonnative species that threaten the native fish community in the mainstem Little Missouri River.

Monitoring

Establish standardized monitoring protocols and locations for native SGCN.
Collect data on fish species occurrence, habitat characteristics, and greenline transects at three or four sites every five years to monitor proposed projects in the basin per the recommendations in Moan et al. (2010).

Establish a standardized fish sampling program at multiple sites in the Little Missouri, Belle Fourche, Cheyenne and Niobrara river drainages (McGree et al. 2010, Moan et al. 2010).

Monitor upstream distributions of introduced fishes present in the Niobrara River in Nebraska. Once every two years, sample the fish community at a site near the Wyoming-Nebraska border.

Monitor water quantity and temperature in areas containing important native SGCN populations.

Monitor the upstream extent of northern pike and other piscivores in the Niobrara River in Nebraska.

Monitor the establishment and spread of other invasive species.

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